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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/644,269	08/19/2003	Stephan E. Lassig	LAM1P111.CIP	7489

25920 7590 03/22/2005

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EXAMINER	
BARRECA, NICOLE M	

ART UNIT	PAPER NUMBER
1756	

DATE MAILED: 03/22/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/644,269	LASSIG ET AL.	
	Examiner	Art Unit	
	Nicole M Barreca	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-24 are pending in this application.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1, 2, 4-12, 14-16, 18-21, 23, 24 are rejected under 35 U.S.C. 102(e) as being anticipated by Okoroanyanwu (US 6,475,904).

5. A first low k dielectric layer 52 is formed on interconnect layer 50 and conductor 51 to a thickness of 7,000 angstroms. The low k dielectric layer may be a suitable material such as BCB, HSQ or FLARE having a dielectric constant less than 4.0. An imageable layer of alicylic polymer 54 is formed to a thickness of 50-400 nm (500-4,000

angstroms). Via pattern 56 is patterned into the imageable layer. A liquid silylation step is performed to incorporate silicon into the imageable layer. Low k dielectric layer 52 is etched to create via opening 58. The oxygen plasma etch also converts the silicon rich regions 53 of the imageable layer 54 into a hard mask 55. After via hole is filled with conductive material, a second low k dielectric layer 62 is spun in the hard mask. The second low k dielectric is of the same thickness and material as the first low k dielectric layer. Second imageable layer 64 is formed of a thickness of about 250 nm (2,500 angstroms) and patterned to form trench opening 66. The second imageable layer is silylated to form hard mask 65. An oxygen etch transfers the trench 68 to the second low k dielectric layer. See col.5, 26-col.7, 20 and Figures 3A-3K.

6. Claims 3, 13, 17, 22 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Okoroanyanwu (with Li (US 6,057,928) cited to show inherent properties).

7. Okoroanyanwu teaches that the low k dielectric material may BBC, HSQ or FLARE, but does not explicitly disclose that the dielectric constant is below about 3.0. Li teaches that the dielectric constant of FLARE polymer is 2.8 (col.8, 61-62). One of ordinary skill in the art would have expect that the low k dielectric layers in Okoroanyanwu had a dielectric constant below about 3.0 because Okoroanyanwu teaches FLARE as an example of a low dielectric constant material used and Li teaches that the dielectric constant of FLARE polymer is 2.8.

8. Claims 20, 21, 23 and 24 are rejected under 35 U.S.C. 102(b) as being anticipated by Konshi (US 6,001,739).

9. An organic insulating layer of a low k dielectric material is formed on a substrate, followed by a photoresist layer. The photoresist is exposed and developed to form a pattern. The photoresist is then silylated by exposing it to a source of HMDS (silicon source) and an oxygen containing plasma. The pattern is then transferred to the insulating layer. See abstract, col.5, 1-col.6, 13 and Figures 2A-2G.

10. Claims 20-21 are rejected under 35 U.S.C. 102(e) as being anticipated by Catabay (US 6,613,665).

11. Barrier layer 10 is formed over an integrated circuit structure 2, which comprises a lower layer of metal interconnects. First layer 20 of low k dielectric material is formed. Low k dielectric layer may comprise a carbon-doped silicon oxide with a thickness of 200-500 nm (2,000-5,000 angstroms). Over the first low k dielectric layer 20 is formed an etch stop layer 30 and second low k dielectric layer 40. The second low k dielectric layer is the same material and thickness as first layer. ARC layer 50 is formed, followed by photomask 60. The thickness of the resist layer will depend on the thickness of the layers to be etched and the particular etch system to be used, as is well known to those skilled in the art (col.4, 33-38). The resist is exposed to form a via pattern, baked to harden and developed. The vias are etched in the second low k dielectric layer 40 and the first low k dielectric layer 20. See col.2, 64-col.4, 60.

12. Claims 1, 2, 6-8 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Catabay.

13. The teachings of Catabay have been discussed above. Catabay is silent on the specific thickness of the photoresist or surface imaging material and does not disclose

that this layer has a thickness of about 500-2,500 angstroms. The reference however does teach that the thickness of the resist layer will depend on the thickness of the layers to be etched and the particular etch system to be used, as is well known to those skilled in the art (col.4, 33-38), thereby teaching that the thickness of the resist layer is a result-effective variable. It would within the ordinary skill of one in the art to determine the film thickness of the resist layer in the method Catabay by routine experimentation and to have a thickness of 500-2,500 angstroms, if required, because the thickness of a photoresist layer is a result-effective variable, as taught Catabay and the discovery of an optimum value of a result effective variable is ordinary within the skill of the art, as taught by *In re Boesch*, (617 F.2d 272, 205 USPQ 215 (CCPA 1980)).

14. Claims 1-24 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Leuschner (US 6,042,993) (with Liu (US 6,287,961) cited to show inherent properties).

15. Leuschner teaches a photolithographic structure generation process comprising a layer of amorphous hydrogen containing carbon applied on a substrate and topped with an electron beam sensitive silicon containing or silylatable photoresist. A two-layer resist system with a top resist layer and a bottom resist layer is used. The top resist is a thin electron beam sensitive photoresist having a thickness of $\leqq$50 nm (500 A) (see claim 1). The said photoresist either contains silicon or can be silylated. A silylatable resist offers the advantage that the layer thickness can be increased by a chemical after treatment and the etching stability in the oxygen plasma can be increased. The bottom resist is relatively thick ($\leqq$500 nm) layer of amorphous C-H (col. 2, 59-col. 3, 13).

Example 1 exemplifies a process wherein the top layer is exposed by means of a scanning tunneling microscope and developed to form a positive image. The wafer is then treated with a silylation solution and the produced structures are transferred to the amorphous hydrogen containing carbon layer by means of plasma etching. The said pattern is then further transferred to the silicon wafer by means of CF4 plasma etch (col. 4, 33-col. 5, 11). Leuschner is silent on the dielectric constant of the amorphous hydrogen containing carbon layer. Liu defines a low dielectric constant dielectric material as a dielectric material having a dielectric constant of less than about 3.0 (col. 1, 43-46). Liu further lists suitable dielectric materials to include amorphous carbon materials such as amorphous carbon and fluorinated amorphous carbon (col. 1, 64-col. 2, 14). One of ordinary skill in the art would have to expect that the amorphous hydrogen containing carbon layer in Leuschner '993 had dielectric constant less than about 3.0 because Liu defines a low dielectric constant dielectric material as a dielectric material having a dielectric constant of less than about 3.0 and lists suitable dielectric materials to include amorphous carbon materials such as amorphous carbon and fluorinated amorphous carbon.

16. Claims 1-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Leuschner (US 5,556,812) in view of Nguyen (US 6,096,634).

17. Leuschner teaches a method for manufacturing multichip modules having layer sequences made of dielectric material. Example 1 teaches the use of a silicon wafer having a copper layer applied over its entire surface. A silicon dioxide layer is applied to the said copper layer as an etch stop layer. The silicon wafer prepared in this manner

serves as a substrate. A polybenzoxazole (PBO) layer is applied as a dielectric layer having a dielectric constant of 2.8 and a thickness of 9 μm (9000 angstroms). A layer of resist based on polyglutarimide is applied by spinning to the dielectric layer. Then, a 0.8 μm (8000 angstroms) thick layer of silylatable resist based on an anhydride group-containing polymer is applied by spinning. After exposure and development, silylation is done at room temperature. Using a plasma etching system the formed patterns are transferred into the PBO layer. A second layer of PBO is applied by spinning to the structured Cu/PBO layer. A layer of silylatable resist is then applied and exposed to form a via hole pattern. The pattern is then silylated and transferred to the PBO layer. The etching process terminates at the copper layer situated hereunder. See col. 7, 66-col. 9, 7 and examples 2 and 3. Leuschner does not disclose that the resist layer has a thickness of about 500-2,500 angstroms. Nguyen teaches that thinner resist layers will result in smaller features (col.1, 29-31), thereby teaching that the thickness of the resist layer is a result-effective variable. It would within the ordinary skill of one in the art to determine the film thickness of the resist layer in the method of Leuschner '812 by routine experimentation and to have a thickness of 500-2,500 angstroms, if required, because the thickness of a photoresist layer is a result-effective variable, as taught by Nuguyen and the discovery of an optimum value of a result effective variable is ordinary within the skill of the art, as taught by *In re Boesch*, (617 F.2d 272, 205 USPQ 215 (CCPA 1980)).

Conclusion

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nicole M Barreca whose telephone number is 571-272-1379. The examiner can normally be reached on Monday-Thursday (9AM-7PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Nicole M Barreca
Examiner
Art Unit 1756

3/17/05